

## REMARKS

### General:

Claims 19-37 are pending in the application. Claims 19-37 stand rejected.

### 35 U.S.C. § 103 rejections:

Independent claims 19 and 32 are rejected as obvious over U.S. Patent No. 4,865,747 (Larson et al.). Larson discloses a device in which a coil 51 (Fig. 3), or preferably a pair of Helmholtz coils (Figs. 1-2) is used to generate an alternating magnetic field across a fluid conduit; or a coil 61 (Fig. 6) is used to generate an alternating magnetic field along the fluid conduit. A ferromagnetic core 31, which is preferably corkscrew-shaped but may be of an unspecified shape, is fixed inside the conduit within the field of the coil or coils. The alternating field is preferably a radio-frequency field of up to 1 GHz, but may be as low as 60 Hz (excited by ordinary 120V AC house current). Thus, the intensity of the magnetic field varies over time at a constant rate determined by the frequency. The direction of the magnetic field may be distorted by the shape of the core, but does not vary over time.

The present invention as now claimed, in contrast, provides a method in which two independently generated magnetic fields intersect at an angle and, by varying one field, or by varying both fields separately, *both the magnitude and the direction* of the resultant field vector are caused to vary rapidly.

The examiner contends that "Larson teaches a method for generating a magnetic field moving in at least one magnetic field plane ... comprising the generating of a first and a second magnetic field ... wherein the magnetic fields vary in direction and amplitude.

Larson does not teach generating a first and a second magnetic field. Figs. 1, 2, and 5 of Larson show a structure with two magnetic coils 13. (The integer 31 is not a coil but a "core portion": the references to "coils 31" at col. 6, lines 19-26 are clearly clerical errors.) However, the coils 13 are Helmholtz coils. See col. 6, line 25. As the examiner is aware, a pair of Helmholtz coils is a device to create an approximately uniform, parallel field. A person skilled in the art would not regard a pair of Helmholtz coils as generating two distinct magnetic fields.

In his remarks on claims 20-21 and 33-34, the examiner argues that the ferromagnetic core 31 of Larson constitutes a permanent magnet, and therefore generates a second magnetic field. The examiner does not identify any specific basis in Larson for this theory. With respect, there is no basis. The core 31 is exactly what Larson says it is: a core positioned within the field of the Helmholtz coils 13. A radio-frequency core must necessarily be of magnetically soft material that would not retain any permanent magnetization. A person skilled in the art would not regard such a core as constituting a second magnet distinct from the Helmholtz coils.

Thus, Larson is not “silent with respect to a predefined angle between the directions of the first and second magnetic fields.” Larson says “Helmholtz coils.” That is a completely unambiguous direction that the fields of the two coils 13 must be coaxial and of equal amplitude. Larson says “core.” That is a completely unambiguous direction that the core imposes a constant distortion on the field from the coils.

Larson does not even clearly mention magnetic fields that vary in direction and amplitude. Larson remarks at col. 1, lines 18-19, that in prior art devices “the magnetic field lines ... must vary in direction **or** magnitude” (emphasis added). At col. 8, lines 36-44, Larson remarks that the theory underlying his device is “not entirely understood” but that [a]ccording to magnetohydrodynamic theory ... the direction **or** magnitude of these magnetic field lines should change or vary” (emphasis added). Larson teaches only devices in which the magnitude of the magnetic field varies over time but its direction is fixed. (Even supposing *arguendo* that the corkscrew shape of the core 31 affects the direction of the field, that effect will be constant.) Further, as discussed in Applicant’s response of February 2001, the prior art of record contains only devices for producing a magnetic field of varying amplitude but constant direction, and devices for producing a magnetic field of varying direction but constant magnitude. There is no reason to suppose that the prior art to which Larson is referring contains devices for producing a magnetic field of both varying direction and varying amplitude. In that context, the better reading of Larson’s remarks is the disjunctive: either a field direction may be varied, or a field magnitude may be varied, but not both.

Further, even if Larson were understood as mentioning a device or method in which both the direction and the amplitude of the magnetic field vary, he does not provide an enabling disclosure of any such device or method. At most, Larson points back into the prior art and, as noted above, the prior art does not appear to provide any such disclosure.

Further, even supposing *arguendo* that Larson did at least mention that both the amplitude and the direction of the field should vary, the examiner's appeal to the cases cited in MPEP § 2144.05 II. does not assist him. In fact, the cases are against the examiner.

A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977), cited at MPEP § 2144.05 II.B.

The present invention seeks to maximize the *rate of change* of the vector product of the intensity by the displacement velocity. There is no disclosure or suggestion in Larson, or anywhere else in the cited prior art, that the *rate of change* of any magnetic field vector is a result-effective variable. On the contrary, even for the magnetic field magnitude vector, Larson allows a range of frequencies from 60 Hz to 1,000,000,000 Hz without calling for any compensating change in peak amplitude, implying that the rate of change of intensity may vary by more than seven orders of magnitude without affecting his process. Because the rate of change of the magnetic field is not recognized in the art as a result-effective variable, optimizing it is *not* routine experimentation, and on the examiner's own theory the present invention, as claimed in claims 19 and 32, is non-obvious.

For all of the above reasons, it is believed that the present invention, as claimed in claims 19 and 32, would not have been obvious to a person of ordinary skill in the art having regard to Larson.

Claims 20-31 and 33-37 are dependent from claims 19 and 32 and, without prejudice to their individual merits, are believed to be allowable for the same reasons as claims 19 and 32.

With respect to claims 20 and 33, the examiner contends that the ferromagnetic core 31 of Larson is a permanent magnet. It is not usual for the core of an electromagnet to be a permanent magnet. There is no suggestion in Larson that the core 31 is an exception.

With respect to claims 21 and 34, the examiner does not even allege that it was obvious to provide two distinct electromagnets in this context, which is an essential feature of those claims.

The examiner asserts that "it has been within the skill in the art that varying current intensity would have been an obvious design choice." First, the examiner misrepresents the cases. The cases say that if a variable quantity is known to be important, then finding the best value of that quantity may be obvious. The cases do not say that replacing a quantity that is fixed at its best value by a quantity that actually varies in use may be obvious, and that is what was done in making the present invention. Second, the examiner has not shown, but has merely asserted, that either the frequency or the intensity of the electromagnet current or the resulting field was known to be important. Larson teaches to the contrary, because he never mentions the current or field strength, and allows the frequency to range over more than seven orders of magnitude (col. 7, lines 41-47). *In re Antonie*, cited above, is completely clear. Unless the examiner can show that a variable was recognized in the art as important, and he has not shown that for any of the key variables here, optimizing those variables does not become obvious.

With respect to claims 22 and 35, the examiner does not even allege that it was obvious to provide phase-shifted currents of different amplitudes to two distinct coils or pairs of coils, which is an essential feature of those claims.

With respect to claims 23 and 36, the examiner does not even allege that it was obvious to provide currents of different frequencies to two distinct coils or pairs of coils, which is an essential feature of those claims.

With respect to claims 24 and 26, it is respectfully pointed out that the whole point of the present invention is to generate magnetic fields having specific magnitudes and directions. It would thus be reasonably expected that changing the position of the magnets generating those fields would have a significant effect on the results achieved. Since this is

not a mere matter of optimizing a variable within a range (The magnets in claims 24 and 26 are either inside the conduit or outside it: there is no range of intermediate positions.) it would not be obvious to move the magnets absent a positive suggestion in the art to do so. The examiner has not shown that any such suggestion existed.

With respect to claim 29, the examiner's argument appears to be self-contradictory, as it explicitly requires the ferromagnetic element 31 of Larson to be simultaneously the core of a radio-frequency (up to 1 GHz) coil, which would require a magnetically very soft material, and a permanent magnet, which would require a magnetically hard material.

For the above reasons also it is believed that the present invention, as claimed in claims 20-24, 26, 29, and 33-36 are non-obvious over the cited prior art.

***Conclusion:***

In view of the foregoing, reconsideration of the examiner's rejections and allowance of claims 19-37 are earnestly solicited.

Respectfully submitted

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